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Whence,

$$u^2 = \frac{k^2}{2}\left(\frac{1-\sqrt{1-c^2}}{\sqrt{1-c^2}}\right),$$

and

$$v^2 = c^2(k^2+u^2) = \frac{c^2k^2}{2}\left(\frac{1+\sqrt{1-c^2}}{\sqrt{1-c^2}}\right).$$

Hence,

$$u = \frac{k}{2\sqrt[4]{1-c^2}}(\sqrt{1+c}-\sqrt{1-c}), \qquad v = \frac{ck}{2\sqrt[4]{1-c^2}}(\sqrt{1+c}+\sqrt{1-c}),$$

and

$$u(v-u) = \frac{k^2}{2}(1-\sqrt{1-c^2}).$$

The available work is h ft. lbs. per sec. per lb. of water used; the work utilized is

$$\frac{u}{g}(v-u) = h(1-\sqrt{1-c^2});$$

the proportion used is $(1-\sqrt{1-c^2})$.

If we let $c = \sin\alpha$, we have $u^2 = gh\tan\alpha\tan\alpha/2$, $v = 2u\cos^2\alpha/2$, and efficiency $= \operatorname{vers}\alpha$.

331. Proposed by CLIFFORD N. MILLS, Brookings, S. Dakota.

A cyclist is riding due west at a speed of 12 miles per hr., and the wind is at the same time blowing from the southeast with a speed of $5\frac{1}{2}$ miles per hour. If the cyclist carries a small flag, in what direction will this flag fly? At what speed would the cyclist need to ride if the flag is to fly due north?

SOLUTION BY B. J. BROWN, Victor, Colo.

The component of the wind north is $11\sqrt{2}/4$ miles per hr., while that west is $11\sqrt{2}/4$ miles per hr. The resistance offered to the machine traveling west is $[12-(11\sqrt{2}/4)]$ and the reaction is toward the east. Hence the forces affecting the flag are $[12-(11\sqrt{2}/4)]$ *toward east*, and $11\sqrt{2}/4$ *toward north* and the direction θ, which the resultant makes with the east-west line $= \arctan 11\sqrt{2}/(48-11\sqrt{2}) = 25° 36' 55''$ N. of E. In order for the flag to fly due N. the rider must travel W. at rate of $11\sqrt{2}/4$ miles per hr. Then he counteracts the resistance E. and *only* the component north is effective.

Also solved by PAUL CAPRON, W. J. THOME, and G. W. HARTWELL.

NUMBER THEORY.

236. Proposed by V. M. SPUNAR, Chicago, Illinois.

Find integral values of x, y, z, such that

$$xy+z=\square,\quad yz+x=\square,\quad xz+y=\square.$$

NOTE BY G. H. LING, University of Saskatchewan.

The following proposition generalizes somewhat the solution of this problem which was given in the February, 1917, MONTHLY.

THEOREM. *If* (1) *a is any integer,* (2) N_1, N_2 *are integers such that* $N_1\cdot N_2 = a^2+1$, (3) $x = N_1-1$, $y = N_2-1$, $z = N_1+N_2-1+2a$, *then*

(I) $xy+z = (a+1)^2;\quad yz+x = (N_2+a-1)^2;\quad zx+y = (N_1+a-1)^2,$

(II) $xy+x+y = a^2;\quad yz+y+z = (N_2+a)^2;\quad zx+x+z = (N_1+a)^2.$

The solution given in the MONTHLY is the special case of this one in which

$$a = n^2+n+1.$$